



290 Elwood Davis Road / Box 3107, Syracuse, New York 13220
 Phone 315-457-5200 · Fax 315-451-0052

JOB Ontario County Landfill / Landfill Expansion
 SHEET NO. 1 OF 8
 CALCULATED BY KCW DATE 11/3/2011
 CHECKED BY _____ DATE _____
 SUBJECT Fugitive PM-2.5 Uncontrolled Emissions Summary

Estimate of Particulate Matter (PM-2.5) Emissions									
PM-2.5 Generation Summary					Emission Reference			lb PM-2.5/ Day	
Waste/Leachate Haul + Site Trucks (Paved Roads)					AP-42: 13.2.1			48.56	
Waste/Leachate Haul + Site Trucks (Unpaved Road)					AP-42: 13.2.2			23.66	
Borrow Trucks (Unpaved Roads)					AP-42: 13.2.2, 13.2.4			8.09	
Borrow Trucks (Unloading)					AP-42: 13.2.4			0.00	
Working Face Cover					AP-42: 11.9			2.65	
							Total =		82.96
82.96	(lb PM-2.5/day) x 1/2000 (ton/lb) x			307	(days/yr) =		12.73		
							12.73		Tons Uncontrolled PM-2.5/Yr
<u>Emissions Estimates Assumptions:</u>									
1) Vehicle weights estimated by vehicle type and load capacity									
* Per Existing daily truck counts (average annual): 212 total waste trucks to the working face per day.									
(50% tractor trailers, 50% straight trucks); 15 onsite trucks to working face per day; 13 Leachate Tankers per day.									
2) All trucks are empty leaving landfill.									
3) Precipitation - Assume 171 precipitation days per year. (>0.01" precip.) (Syracuse, NY Data)									
4) Vehicle Speeds average 15 mph.									
5) Solid waste and sludges contains no PM-2.5 content.									
Assume ALL PM-2.5 generated from road traffic & cover soil operations.									
6) Assume negligible weight change on support vehicle trips (i.e. same weight in/out).									
7) Mean Wind Speed - Assume 9.4 MPH (Syracuse, NY data)									
8) 307 operational days per year - max potential annual operations									
9) Road lengths determined from analysis of CAD site plans									



290 Elwood Davis Road / Box 3107, Syracuse, New York 13220
 Phone 315-457-5200 · Fax 315-451-0052

JOB Ontario County Landfill / Landfill Expansion
 SHEET NO. 2 OF 8
 CALCULATED BY KCW DATE 11/3/2011
 CHECKED BY _____ DATE _____
 SUBJECT Fugitive PM-2.5 Emissions - Paved Roads

<u>Estimate of Particulate Matter (PM-2.5) Emissions</u>										
<u>Paved Roads - Emission Factors Derived from AP-42: 13.2.1 (1/11)</u>										
$E_{ext} = [k \times (sL)^{0.91} \times (W)^{1.02}] \times (1-P/4N)$										
<u>Where:</u>										
E _{ext} = Annual size-specific emission factor extrapolated for natural mitigation (lb/VMT)										
k = PM-2.5 multiplier (lb/VMT) = 0.00054 lb/VMT (Table 13.2-1.1)										
sL = Road Surface Silt Loading (g/m ²) = 7.4 g/m ² (Table 13.2.1-4)										
W = Mean Vehicle Weight (tons)										
P = Number of precipitation days per year (>0.01 in precipitation) = 171 days (Syracuse, NY Data)										
N = Number of days in the averaging period = 365 days (Annual average)										
<u>Vehicles to Working Face (WF):</u>										
106	Straight Trucks	==> average weight =						20	tons	
106	Tractor Trailers	==> average weight =						32.5	tons	
15	Support Vehicles (Onsite)	==> average weight =						2.1	tons	
							W(WF) =	24.7	tons	
<u>Tanker Trucks to Leachate Loadout (LL):</u>										
13	Tanker Truck per day (peak leachate gen)	==> average weight =						32	tons	
							W(LL) =	32	tons	
<u>Length of Paved Roads:</u>										
Length of paved roads leading to working face						L(WF) =	1.35	miles		
Length of paved roads leading to leachate loadout						L(LL) =	0.52	miles		
$E(WF) = [0.00054 \times (7.4)^{0.91} \times (W)^{1.02}] \times (1-171/(4 \times 365)) =$										
							0.077	lb/VMT		
227	Trips/day x 2 ways x	1.4	miles x	0.077	lb/VMT =	47.19	lb PM-2.5/day			
$E(LL) = [0.0024 \times (7.4/2)^{0.65} \times (W/3)^{1.5} - 0.00036] \times (1-171/(4 \times 365)) =$										
							0.101	lb/VMT		
13	Trips/day x 2 ways x	0.5	miles x	0.101	lb/VMT =	1.37	lb PM-2.5/day			
							TOTAL =	48.56	lb PM-2.5/day	



290 Elwood Davis Road / Box 3107, Syracuse, New York 13220
 Phone 315-457-5200 · Fax 315-451-0052

JOB Ontario County Landfill / Landfill Expansion
 SHEET NO. 3 OF 8
 CALCULATED BY KCW DATE 11/3/2011
 CHECKED BY _____ DATE _____
 SUBJECT Fugitive PM-2.5 Emissions - Unpaved Roads

Estimate of Particulate Matter (PM-2.5) Emissions

Unpaved Roads - Emission Factors Derived from AP-42: 13.2.2 (11/06)

$$E_{\text{ext}} = k (s/12)^a (W/3)^b \times [(365 - P)/365]$$

Where:

E_{ext} = Annual size-specific emission factor extrapolated for natural mitigation (lb/VMT)

s = Surface material silt content for MSW Landfills (%) = 6.4 % (Table 13.2.2-1)

W = Mean Vehicle Weight

k = 0.15 lb/VMT (Table 13.2.2-2)

a = 0.9 (Table 13.2.2-2)

b = 0.45 (Table 13.2.2-2)

P = Number of precipitation days per year (>0.01 in precipitation) = 171 days (Syracuse, NY Data)

$$E_{\text{ext}} = 0.15 \times (6.4/12)^{0.9} \times (W/3)^{0.45} \times [(365-171)/365] = \text{lb per vehicle mile traveled}$$

Length of Unpaved Roads:

L(WF) = 0.43 miles Length of unpaved road to working face.

L(LL) = 0.24 miles Length of unpaved road to leachate loadout.

$$E(\text{WF}) = 0.15 \times (6.4/12)^{0.9} \times (W/3)^{0.45} \times [(365-171)/365] = 0.117 \text{ lb/VMT}$$

$$227 \text{ Trips/day} \times 2 \text{ ways} \times 0.43 \text{ miles} \times 0.117 \text{ lb/VMT} = 22.84 \text{ lb PM-2.5/day}$$

$$E(\text{LL}) = 0.15 \times (6.4/12)^{0.9} \times (W/3)^{0.45} \times [(365-171)/365] = 0.131 \text{ lb/VMT}$$

$$13 \text{ Trips/day} \times 2 \text{ ways} \times 0.24 \text{ miles} \times 0.131 \text{ lb/VMT} = 0.82 \text{ lb PM-2.5/day}$$

$$\text{TOTAL} = 23.66 \text{ lb PM-2.5/day}$$



290 Elwood Davis Road / Box 3107, Syracuse, New York 13220
 Phone 315-457-5200 · Fax 315-451-0052

JOB Ontario County Landfill / Landfill Expansion
 SHEET NO. 4 OF 8
 CALCULATED BY KCW DATE 11/3/2011
 CHECKED BY _____ DATE _____
 SUBJECT Fugitive PM-2.5 Emissions - Borrow Trucks/Soil Mining

Estimate of Particulate Matter (PM-2.5) Emissions											
Borrow Trucks (Unpaved Roads): Emission Factors Derived from AP-42: 13.2.2 (11/06)											
W = Mean Vehicle Weight											
Full Truck =		55.84	tons	(Terex A30D max. gross vehicle weight)							
Empty Truck =		24.84	tons	(Terex A30D manufacturer specifications)							
Wave =		40.34	tons	42	= average number of loads per day (assume full load)						
E _{ext} = 0.15 x (6.4/12) ^{0.9} x (W/3) ^{0.45} x [(365-171)/365] = 0.146 lb/VMT											
Assume borrow trucks haul 12 months of the year. Actual usage expected to be less.											
Average length of unpaved road =		3,500	feet								
		3,500	x 1 mile/5,280 feet =	0.66	miles						
Borrow trucks currently haul approximately		42	loads per day.								
42 loads/day x 2 ways x		0.66	miles =	55.44	VMT						
PM-2.5 =		55.44	VMT x	0.146	lb/VMT =	8.09 lb PM-2.5/day					
Soil Mining (Unloading): Emission factors derived from AP-42: 13.2.4 "Aggregate Handling and Storage Piles" (11/06)											
From 13.2.4 equation (1):			where:								
E = k(0.0032) x (U/5) ^{1.3}			E = Material handling emission factor (lb/ton handled)								
(M/2) ^{1.4}			k = Particle size multiplier =			0.053					
			U = Mean wind speed (miles per hour (mph)) =			9.4	(Syracuse, NY)				
			M = Material Moisture Content (%) =			12	(Table 13.2.4-1)				
E = 0.053 (0.0032) x (9.4/5) ^{1.3}			=			0.0000	lb PM-2.5/ton				
(12/2) ^{1.4}											
Average daily cover mining is approximately		1300	tons								
PM-2.5 =		0.0000	lb PM-2.5/ton x	2 (load/unload) x	1300	tons =	0.00 lb PM-2.5/day				



290 Elwood Davis Road / Box 3107, Syracuse, New York 13220
 Phone 315-457-5200 · Fax 315-451-0052

JOB Ontario County Landfill / Landfill Expansion
 SHEET NO. 5 OF 8
 CALCULATED BY KCW DATE 11/3/2011
 CHECKED BY _____ DATE _____
 SUBJECT Fugitive PM-2.5 Emissions - Working Face

Estimate of Particulate Matter (PM-2.5) Emissions

Working Face Cover Operations:

Emission Factors Derived from AP-42: 11.9 (10/98), 13.2.3 (11/06), 13.2.4 (11/06)

Equipment Utilized Include:	3	John Deere 850 Bulldozer	2	hours per day
	1	John Deere 1050 Bulldozer	2	hours per day

Assumptions:

- 1) Waste materials arrive moist - no significant PM-2.5.
- 2) Worst case - all machinery working at the same time.
- 3) Assume cover soils are used 12 months of the year.

Emissions based on Table 11.9-1 Bulldozer Emissions

$$E = \frac{5.7 \times (s)^{1.2} \times (0.105)}{(M)^{1.3}}$$

where:

E = PM-2.5 emissions (lb/hr) (from Table 11.9-1)
 s = Material silt content (%) = 9 (AP-42 13.2.4 - Table 13.2.4-1)
 M = Material moisture content (%) = 12 (Table 13.2.4-1)

$$E = \frac{5.7 \times (9)^{1.2} \times (0.105)}{(12)^{1.3}} = 0.331 \text{ lb/hr}$$

3	Bulldozer	0.331 lb/hr x	2 hrs/day =	1.99
1	Bulldozer	0.331 lb/hr x	2 hrs/day =	0.66

Total = 2.65 lbs PM-2.5/day



290 Elwood Davis Road / Box 3107, Syracuse, New York 13220
 Phone 315-457-5200 · Fax 315-451-0052

JOB Ontario County Landfill / Landfill Expansion
 SHEET NO. 6 OF 8
 CALCULATED BY KCW DATE 11/3/2011
 CHECKED BY _____ DATE _____
 SUBJECT Fugitive PM-2.5 Emissions Control Efficiency

<u>Efficiency of Mitigation Measures on Particulate Matter (PM-2.5) Emissions:</u>									
<u>Paved Roads:</u>									
For Paved Roads, control efficiency can be estimate by Table 2-4 from <u>Control of Open Fugitive Dust Sources</u> (Cowherd, Et. Al. for USEPA), which states that the control efficiency of water flushing has been measured in the field as:									
<i>Assume PM-10 control is the same for PM-2.5.</i>									
Cited Efficiency of water flushing (%) = $69 - 0.231 V$,									
where V = # of vehicle passes since application									
<i>Assume all vehicles entering landfill travel paved roads to be conservative.</i>									
<u>Average number of vehicle passes since last application:</u>									
240	Combined vehicles/ day x 2 directions =				480	Vehicle passes/day			
4	# times roads watered per day								
480	passes/day / # applications/day =				120	= V = Average Veh. Passes between applications			
For paved roads, the estimated efficiency is:									
$C_{paved} (%) = 69 - 0.231 (V)$									
$C_{paved} =$	41.3	%							
<u>Unpaved Roads:</u>									
For Unpaved Roads, control efficiency can be estimate by equation 3-2 from <u>Control of Open Fugitive Dust Sources</u> (Cowherd, Et. Al. for USEPA), which states that the control efficiency of unpaved road watering is:									
$C_{unpaved} = 100 - \frac{[0.8(p)(d)(t)]}{i}$									
where:									
C = Average control efficiency (%)									
p = Potential average hourly daytime evaporation rate (mm/hr)									
p = 0.0049 x (Value in Figure 3-2) for Annual Conditions									
d = Daily average daytime traffic rate (h ⁻¹)									
i = Application intensity (l/m ²)									
t = Time between applications (h)									



290 Elwood Davis Road / Box 3107, Syracuse, New York 13220
 Phone 315-457-5200 · Fax 315-451-0052

JOB Ontario County Landfill / Landfill Expansion
 SHEET NO. 7 OF 8
 CALCULATED BY KCW DATE 11/3/2011
 CHECKED BY _____ DATE _____
 SUBJECT Fugitive PM-2.5 Emissions Control Efficiency

Efficiency of Mitigation Measures on Particulate Matter (PM-2.5) Emissions:																			
Assume PM-10 control is the same for PM-2.5																			
Using average annual evaporation conditions for the site,																			
P = 0.0049 x (40) = 0.196 mm/h																			
The average daytime traffic rate "d" is estimated by dividing the number of vehicle passes per day by the average length of day. For unpaved roads = 480 vehicle passes per day (2 directions - includes waste vehicles traveling on road to working face. It is assumed that the borrow road is not watered). So,																			
480 vehicle passes per day / 8 (hrs/day) = 60 Vehicles per hour																			
The application intensity "i" has been estimated at 2.174 liters per square meter. This value was the factor (0.48 gal/yd ²) for water flushing in Control of Open Fugitive Dust Sources (Cowherd, Et. Al. for USEPA).																			
The control efficiency realized by watering unpaved roads was calculated using eight hours between applications. Unpaved roads are watered a minimum of four times daily, and more frequent as site conditions require.																			
4 hours between applications (2x/day)																			
The resulting control efficiency is:																			
C _(4x/day) = 82.7 %																			



290 Elwood Davis Road / Box 3107, Syracuse, New York 13220
 Phone 315-457-5200 · Fax 315-451-0052

JOB Ontario County Landfill / Landfill Expansion
 SHEET NO. 8 OF 8
 CALCULATED BY KCW DATE 11/3/2011
 CHECKED BY _____ DATE _____
 SUBJECT Fugitive 2.5 Controlled Emissions

Applying Efficiency of Mitigation Measures to the Estimated Particulate Matter (PM-2.5) Emissions:			
PM-2.5 Generation Summary	Uncontrolled PM-2.5 (lb/day)	Control Eff (%)	Controlled PM-2.5 (lb/day)
Waste/Leachate Haul + Site Trucks (Paved)	48.56	41.3	28.51
Waste/Leachate Haul + Site Trucks (Unpaved)	23.66	82.7	4.10
Borrow Trucks (Unpaved Roads)	8.09	0.0	8.09
Borrow Trucks (Unloading)	0.00	0.0	0.00
Working Face Cover	2.65	0.0	2.65
	83.0		43.35
43.35 (lb PM-2.5/day) x 1/2000 (ton/lb) x 307 (days/yr) = 6.65			
		6.65	Tons Controlled PM-2.5/Yr
		13,308	Pounds Controlled PM-2.5/Yr
Overall Control Efficiency =	47.7%		